

FRONT-OPENING UNIFIED POD AUTO-LOADING

STRUCTURE

BACKGROUND OF THE INVENTION

Field of the Invention:

The present invention relates to a FOUP (front-opening unified pod) auto-loading structure and, more particularly, to such FOUP auto-loading structure, which is suitable for use in the loading-in-interface port of a wafer manufacturing process/equipment to automatically close/open the cover of a

10 FOUP.

Brief Description of the Prior Art:

Current wafer process puts in the fabrication of wafers, wafers are put in a unified pod such that, and the purity of the small inner inside space of the unified pod is well controlled.

15 Because the purity of the small inner inside space of the unified pod is well controlled, the purity of the external cleaning room is less critical. This measure saves much clean expenditure on the wafer manufacturing equipment cleaning cost. However, external dust or human body dust may be carried in the manufacturing **20** equipment when opening the cover of the unified pod manually, so as to causing bring about a contamination to wafers.

SUMMARY OF THE INVENTION

The invention has been accomplished to provide a FOUP

auto-loading structure, which eliminates the citedaforsaid problem. It is anthe main object of the present invention to provide a FOUP auto-loading structure, which automatically loads the FOUP for in-and-opening or s/closinges its coverthe FOUP, 5 thereby preventing a wafers from contamination to wafers. It is another object of the present invention to provide a FOUP auto-loading structure, which can beforms a part of the automation of the an full-automated wafer manufacturing process.

To achieve the aforesaid objects and according to one 10 aspect of the present invention, the FOUP auto-loading structure of the present invention comprises a machine base, a carrier, a sliding control mechanism, a latch-mechanism, a horizontal shifting mechanism and a lifting mechanism. tThe machine base with an upper access has comprising a backboard with an upper 15 access, a table against on the middle of the backboardward, and a base against at a bottom side of the backboard, the backboard having an access on an upper side of the backboard; a The carrier carriage supported by on the table is and adapted to carry a FOUP₅. tThe carrier has carriage having an elongated opening 20 close by the backboard hole through top and bottom sidewalls thereof; a The sliding control mechanism is mounted on the table to support the carriercarriage and controlled it to move the carriage on the table toward or away from the access; a clamp The

latch mechanism below the carrier has mounted on the bottom sidewall of the carriage, the clamp mechanism comprising a rail fixedly fastened onto the bottom thereof sidewall of the carriage, a screw rodthreaded rod disposed in parallel to the rail of the 5 clamp latch mechanism, a sliding pade threaded onto the screw rodthreaded rod of the clamp latch mechanism and adapted to slide move along the rail of the clamp latch mechanism upon rotary motion of the screw rod of the clamp mechanism, a motor adapted to rotate the screw rodthreaded rod of the clamp latch mechanism 10 clockwise/counter-clockwise so as to make the sliding pad slide forwardly and backwardly, and a clamp locking plate fixedly mounted on the sliding pade of the clamp latch mechanism and adapted to latch the FOUP on the carrier by inserting through the elongated opening hole of the carriage carrier and adapted to be 15 moved to a retaining portion of the carrier with the sliding pade of the clamp latch to a retaining portion of the carrier mechanism to clamp the FOUP being carried on the carriage; a horizontal shifting mechanism, The horizontal shifting mechanism has a comprising rail means fixedly mounted on the base of the 20 machine base, a horizontal screw rodthreaded rod disposed in parallel to the rail means of the horizontal shifting mechanism, a platform threaded onto the screw rodthreaded rod of the horizontal shifting mechanism, and a motor to drive and control the platform

to move horizontally along the rail of the horizontal shifting mechanism as clockwise/counter-clockwise rotating controlled to rotate the screw rod~~threaded~~ rod of the horizontal shifting mechanism clockwise/counter-clockwise, thereby moving for

5 causing the platform to be moved horizontally along the rail means of the horizontal shifting mechanism toward/away from the backboard of the machine base; and a lifting mechanism, t_The lifting mechanism has comprising a motor and a screw rod~~threaded~~ rod and slider set vertically mounted on the platform of the

10 horizontal shifting mechanism, t_The screw rod~~threaded~~ rod and slider setcomprising has a vertical rail, a screw rod~~threaded~~ rod longitudinally mounted in the vertical rail, a sliding pade threaded onto the screw rod~~threaded~~ rod of the lifting mechanism and moved along the vertical rail upon the rotation~~rotary motion~~ of the

15 screw rod~~threaded~~ rod of the lifting mechanism. According to another aspect of the present invention, the FOUP auto-loading structure further comprises a headstock gear~~ever close/open control mechanism~~ moved with the sliding pade of the lifting mechanism and controlled to close/open the cover of the FOUP

20 being carried on the carriage~~carrier~~. According to still another aspect of the present invention, the cover close/open control mechanism comprises:headstock gear has a gate, two racks, two support arms and a driving unit. fitting and adapted to be The

gate moves in and out of the access of the backboard of the machine base, ~~the gate having two through holes; The two racks are respectively fixedly fastened onto a surface back sidewall of the gate that does not contact the FOUP.~~ The two support arms are respectively extended from the racks and connected to the sliding pade of the lifting mechanism; and a ~~The driving unit mounted above the two racks on a back sidewall of the gate and controlled to close/open the cover of the FOUP being carried on the carriage carrier, the driving unit has comprising a transmission~~

5 shaft, a motor controlled to rotate the transmission shaft, two rotary bolts respectively coupled to the transmission shaft and inserted through the through holes of said gate and adapted for engaging into the lockating holes ~~and for turning rotating with~~ by the transmission shaft to thus close/open the cover of the FOUP

10 ~~being carried on the carriage carrier. According to still another aspect of the present invention, carriage~~ the carrier has a round opening for inserting through a locking bolt engaginged with a locking bolt control motor to thus comprises an escape hole, a motor fixedly mounted on a bottom sidewall thereof, and a locking

15 bolt inserted through the escape hole and coupled to the motor at the carriage and rotated by the motor at the carriage to lock the FOUP on the carriage carrier.

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Other objects, advantages, and novel features of the

invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

5 FIG. 1 is a perspective view of a FOUP auto-loading structure according to the present invention.

FIG. 2A is an exploded view of a part of the present invention, showing the arrangement of the ~~clamp~~latch-mechanism, the locking bolt and locking bolt control motor, the sliding control 10 mechanism, and the table.

FIG. 2B is a sectional view of a part of the present invention, showing the arrangement of the ~~clamp~~latch-mechanism, the locking bolt and locking bolt control motor, and the sliding control mechanism between the ~~carriage~~carrier and the table.

15 FIG. 3 is a perspective view of the lower part of the present invention, showing the arrangement of the horizontal shifting mechanism and the lifting mechanism.

FIG. 4 is a perspective backside view of a part of the present invention, showing the arrangement of the lifting 20 mechanism, the horizontal shifting mechanism, and the ~~cover~~
~~close/open control mechanism~~headstock gear.

FIG. 5 is a perspective view in an enlarged scale of the upper part of FIG. 4.

FIG. 6 is a schematic cross-section~~drawing~~ showing the operation of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a typical FOUP (front-opening unified pod) 8 and an inventive FOUP auto-loading structure areis shown, wherein the inventive structure is applied for automatically loading a cover 82 of the FOUP 8 and opening/closing the cover. In addition to the cover 82, the FOUP 8 also includes comprising an front-opening 81; closed by the cover 82a cover 82that closes the opening 81, and a bottom platepanel 83. The cover 82 has two locking holes 821 and 821'. The bottom panelplate 83 comprises a positioning portion~~hole~~ 831 at the center, and a retaining portion 832 at a side close by the cover~~at a front side~~. The invention is used to load and open/close the cover 82 of the FOUP 8.

Referring to FIGS. 1 and 2, the inventive FOUP auto-loading structure includes a machine base 1, a carrier 2, a sliding control mechanism 21, a latch mechanism 4, a horizontal shifting mechanism 5 and a lifting mechanism 6. The machine base, referenced by 1, with an upper access 110 comprises a backboard 11 fixedly fastened disposed against~~to~~ the loading port of the manufacturing equipment 9. The back board 11 has a table 12 is transversely disposed against~~on~~ the middle of the backboard

11, a base 13 fixedly provided at the disposed against bottom side thereof of the backboard 11, an access 110 disposed at the upper side of the backboard 11 above the table 12, two parallel sliding slots 111 and 112 longitudinally vertically disposed at the 5 backboard 11 and below the table 12 (see also FIG. 4), and a packing member gasket 113 fastened on edges to the border of the access 110 at the front side facing the FOUP 8 and adapted to match with accommodate the front-opening 81 of the FOUP 8.

The carriage carrier, referenced by 2, comprises has three 10 upright locating pin positioning rods 201 disposed corresponding to three positioning grooves 833 at the bottom panel plate 83 of the unified pod FOUP 8 for the positioning of the FOUP 8 on the carriage 2, two first upright detecting pins 202 and 202' corresponding to two round recessed holes 834 and 834' at the 15 bottom panel plate 83 of the FOUP 8 for detecting the a front-end stage manufacturing process or rear stage backend manufacturing process, two second upright detecting pins 203 and 203' corresponding to detecting recesses inspection holes 835 and 835' at the bottom panel plate 83 of the FOUP 8 for 20 detecting if the a type of the unified pod FOUP 8 is a to be the 13-piece unified pod or 25-piece unified pod, and a third upright detecting pin 206 (see FIG. 2B) to determine if the FOUP 8 is positioned correctly. If the FOUP 8 does not match the upright

detecting pins 201, 202 and 203, the bottom panel plate 83 is tilted and cannot force press down the third upright detecting pin 206. In this case, it means that the FOUP 8 is not correctly positioned. The carriage 2 further comprises has an escape hole a 5 round opening 204, to accommodate a locking bolt 3 (described later) and an elongated opening hole 205 to accommodate a locking plate 45 (described later).

FIG. 2A shows the carriage carrier 2 supported by a sliding control mechanism 21 above on the table 12. The sliding 10 control mechanism 21 comprises has two parallel rails 22 and 22' fixedly mounted on the table 12, a front limit switches 221 and a rear limit switch 221' respectively disposed at front and rear two ends of one rail 22, two sliding pads 23 and 23' fixedly fastened to the bottom side wall of mounted respectively on the parallel 15 rails 22 and 22' of the carriage carrier 2 for movement and moved with the carriage along the rails 22 and 22', a screw rod threaded rod 25 fixedly mounted on the table 12 below the sliding pad 23 close by the limit switches 221 and 221', and a reversible motor 24 adapted to rotate the screw rod threaded rod 25 20 clockwise/counter-clockwise. One The sliding pade 232 is threaded onto the screw rod threaded rod 25. When starting the reversible motor 24 to rotate the screw rod threaded rod 25 clockwise or counter-clockwise, the carriage carrier 2 is moved

with the sliding pades 23 and 23' along the rails 22 and 22' toward or away from the access 110.

Referring to FIG. 2B and FIG. 2A again, a locking bolt control motor 31 and a clampatch mechanism 4 are fixedly fastened to the bottom sidewall of the carriagecarrier 2. A locking bolt 3 is a T shape with a stem coupling to the locking bolt control motor 31 through limit switches 311, 311' and a head is insertinged through the escape hole round opening 204 of the carriagecarrier 2, having a front end protruding over the topside of the carriage 2 for inserting into the positioning portionhole 831 of the bottom panelplate 83 of the FOUNP 8 and a rear end coupled to the locking bolt 3. After insertingon of the locking bolt 3 into the positioning portionhole 831 of the bottom panelplate 83 of the FOUNP 8, the locking bolt control motor 31 is operated to rotates the locking bolt 3 bythrough 90° angle to lock the FOUNP 8. The limit switches 311 and 311' are provided to control forward/backward turning operation of the motor 31 through to rotate clockwise or counterclockwise 90°. The front limit switch 221 and rear limit switch 221' control the locking bolt control motor 31 to rotate 90° forwards or backwards, so as to turn the unlockmove the locking bolt 3 between the locking position and the unlocking positions.

The clampatch mechanism 4 comprises has a rail 41, a

sliding pad 42, a motor 43, a threaded rod 44, the locking plate 45, limit switches 411, 411' and rollers 46. The rail 41 is fixedly fastened to a the bottom of the latch 4 in parallel to the sidewall of the carriage 2, a screw rod threaded rod 44 disposed in parallel to the rail 41, on which a slide 42 is disposed to threaded onto the screw rod threaded rod 44 and moved along the rail 41 with rotation of the upon rotary motion of the screw rod threaded rod 44, a The front limit switches 411 and a rear limit switch 411' are respectively mounted on the front and rear two ends of the rail 41, and a motor 43 is controlled to rotate the screw rod threaded rod 44, and a clamp. The latch locking plate 45 is fixedly mounted on the sliding pade 42 and inserted through the elongated openinghole 205 of the carriage carrier 2 and adapted to clamp the retaining portion 832 of the bottom panelplate 83 of the FOUP 8. Clockwise/counter-clockwise Rrotation ofg the motor 43 clockwise/counter-clockwise drives causes the clamp the locking latch plate 45 to be moved forwardly and backwardly with the sliding pade 42 forwards or backwards, and therefore the clamp locking latch plate 45 is pressed on or released from the retaining portion 832 of the bottom panelplate 83 of the FOUP 8. Further, the plastic rollers 46 are bilaterally provided disposed at the topside of the clamp locking latch plate 45, which in order to prevent damage to the retaining portion 832 from being damaged

as upon the retaining portion 832 presses down on ~~ing of the clampplatelocking plate 45 on the retaining portion 832,~~ and eliminates the production of dust caused by ~~due to~~ friction between the retaining portion 832 and the ~~clampplatelocking plate~~

5 45.

Referring to FIG. 3, a horizontal shifting mechanism 5 and a lifting mechanism 6 are respectively installed overin the base 13 of the machine base 1. The horizontal shifting mechanism 5 ~~comprises has two parallel rails 51 and 51'~~— disposed respectively 10 on the base 13 of the machine base 1 horizontally arranged in parallel and extended perpendicular to the backboardward 11, a fronttwo limit switches 511 and a rear limit switch 511' respectively ~~provided disposed at the front and rear two ends of one rail 51~~, a horizontal screw rodthreaded rod 53 disposed in 15 parallel above the elevation of and in parallel to the rails 51 and 51', a platform 52 threaded onto ~~by~~ the screw rodthreaded rod 53 and slidably movably supported ~~by~~ on the rails 51 and 51', and a motor drive 54 controlled to rotate the screw rodthreaded rod 53 clockwise/counter-clockwise. Rotating the screw rodthreaded rod 20 53 clockwise/counter-clockwise causes so as to move the platform 52 to be moved horizontally forwardlys/backwardlys along the rails 51 and 51' relative to the backboard 11. The lifting mechanism 6 ~~comprises has~~ a screw rodthreaded rod and slider set

61 and an upright motor 65 vertically-mounted on the platform 52 of the horizontal shifting mechanism 5. The ~~screw rod~~threaded rod and slider set 61 ~~comprises~~has a vertical rail 62 of U-shaped cross section having an outward opening side facing to the outside, two 5 guide rods 621 perpendicularly extended from the back sidewall of connecting the vertical rail 62 to and the backboard 11 by inserting through respective guide holes 114 of the backboard 11 and adapted to for guiding the vertical rail 62 to horizontally movement of the vertical rail 62 with the platform 52, a screw 10 ~~rod~~threaded rod 64 longitudinally vertically mounted in the vertical rail 62, a sliding pade 63 threaded onto the screw ~~rod~~threaded rod 64 and moved along the vertical rail 62 as upon rotatingry motion of the screw ~~rod~~threaded rod 64, and a limit switch 622 mounted in the vertical rail 62 and adapted to limit 15 down reduce an impact stroke of the sliding pade 63. The motor 65 is controlled to rotates the screw ~~rod~~threaded rod 64 clockwise/counter-clockwise to thus move, causing the sliding pade 63 to be moved upwardlys/downwardlys along the vertical rail 62.

20 Referring to FIGS. 4 and 5 and FIG.1 again, a cover close/open controlheadstock gear mechanism 7 is provided disposed on a at the backside of the backboard 11. The cover close/open controlheadstock gear mechanism 7 comprises has a

gate 71 fitting the access 110 of the backboard 11, and a packing member gasket 712 fastened ~~to the border on edges~~ of the gate 71 at a surface 110 not contacting the FOUP 8 at the front side and adapted to accommodate ~~match~~ with the cover 82 of the FOUP 8.

- 5 The gate 71 comprising ~~has~~ two front positioning pins 713 adapted respectively ~~to~~ engaged to the recessed positioning recesses holes 822 and 822' on the cover 82 of the FOUP 8 and to prevent ~~stop~~ the FOUP 8 from displacement and two through holes 711 corresponding to the lock~~a~~ting holes 821 and 821' of the cover 10 82 of the FOUP 8. — The headstock gear 7 also has two parallel racks 72 and 72' fixedly fastened ~~on a~~ ~~to~~ the back sidewall of the gate 71 and arranged ~~in parallel~~, two support arms 73 and 73' respectively forwardly extended ~~from~~ disposed over the racks 72 and 72' below the gate 71 in order to ~~and~~ inserted through the 15 sliding slots 111 and 112 of the backboard 11 and fixedly connected to the sliding pade 63 of the screw ~~rod~~ threaded rod and slider set 61 of the lifting mechanism 6 for enabling the gate 71 to be moved horizontally and vertically by ~~with~~ the horizontal shifting mechanism 5 and the lifting mechanism 6, and a driving 20 unit 74 mounted on the back sidewall of the gate 71 and controlled to close/open the cover 82 of the FOUP 8. — The driving unit 74 comprises ~~has~~ a transmission shaft 76, a motor 75 controlled to rotate the transmission shaft 76, two rotary bolts 77 and 77'

respectively coupled to the transmission shaft 76 and inserted through the through holes 711 of the gate 71 and adapted for engaging into the lockating holes 821 and 821' of the cover 82 of the FOUP 8 to open the cover 82 from the opening 81 of the FOUP

- 5 8. Further, at least one, for example, two detectors 78 are provided disposed on at the topside of the gate 71. After removal of opening the cover 82 from the opening 81 of the FOUP 8, the detectors 78 are moved with the gate 71 up and down relative to the FOUP 8 to detect the wafer number and positioning of the wafers in the FOUP
- 10 8. There is also provided In addition, a detector 79 is mounted on the back sidewall of the backboard 11 above the access 110, and adapted to detect protrusiveon of wafers in the FOUP 8, so as to prevent wafers from damage whento the wafers upon closing/opening of the cover 82.

- 15 As stated above, when the FOUP 8 is carried to the carriagecarrier 2 by handlabor or an automatic truck, the correct positioning of the FOUP 8 is detected by the upright detectingon pins 202, and 203 and 206, and then the third upright detectingon pin 206 is pressed down to startturn on the motor 31, causing the
- 20 motor 31 to rotate the locking bolt 3 in one direction throughby 90°, and therefore the locking bolt 31 is forced into engagedment with the positioning portionhole 831 on the bottom panelplate 83 of the FOUP 8. At the same time, the motor 43 of the clampplatch

mechanism 4 is turned on to rotates the screw rod threaded rod 44, to move causing the clamp plate locking plate 45 to be moved with the sliding pade 42 and forced into engagement with the retaining portion 831 of the bottom panel plate 83 of the FOUP 8. This 5 double-locking effect keeps can ensure accurately forward movement of the FOUP 8 in course. The sliding control mechanism 21 is then driven to moves the carriage carrier 2 and the FOUP 8 forwardlys, causing the opening 81 of the FOUP 8 to be forced into close contact with the packing member gasket 113 of the 10 access 110. Therefore, when the motor 75 of the driving unit 74 is started to rotates the rotary bolts 77 and 77' for opening the cover 82, the FOUP 8 is maintained free from contamination. Thereafter, the horizontal shifting mechanism 5 is operated to moves the cover 82 horizontally and backwardlys, and then the 15 lifting mechanism 6 is operated to lowers the cover 82, for allowing the internal mechanical arm of the manufacturing equipment 9 to pick up the carry wafers from the FOUP 8. On the contrary, when closing the cover 82 on the FOUP 8, the aforesaid procedure is repeated reversely. Therefore, the FOUP 8 can be 20 automatically opened and closed in the manufacturing equipment 9 without causing contamination.

Although the present invention has been explained in relation to its preferred embodiment, it is to be understood that

many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.